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THE STORY OF INOSITOL. I.

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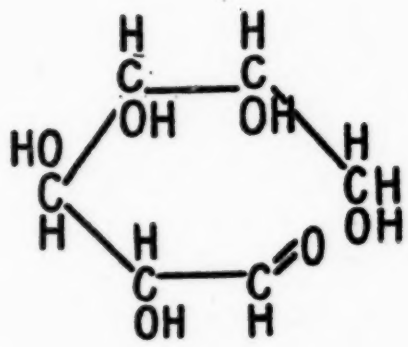
THE STORY OF INOSITOL. I.

By RUTH WOODS

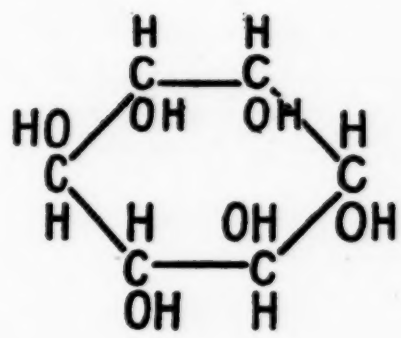
Inositol has been known to chemists for almost a century, but it was not until twenty years ago that its significance as a factor in microbial nutrition was discovered. This discovery received little attention until seven years ago when inositol was found to be a nutritive essential not only for microorganisms but for higher animals as well. Since that time the dietary value of inositol has been demonstrated for an increasing number of animal species, including man. Whether inositol is, however, an absolutely indispensable constituent of the diet is still a much-debated question and one which awaits further experimental studies and a clearer understanding of the biological role of this substance in the body economy. Present knowledge of inositol indicates that a deficiency of this factor inhibits growth and is associated with specific deficiency symptoms which vary according to the species involved. The chief biochemical function of inositol appears to be one associated with the various phases of fat metabolism, the compound being particularly concerned with the phenomenon of lipotropism.

Discovery and Early History:

Inositol was discovered in animal tissues, particularly in muscle, by the German chemist Scherer (1) in 1850 and was reported by Maquenne (2) nearly forty years later, to be a hexahydroxycyclohexane (Fig. 1) comparable to a cyclic form of glucose.



d-glucose



i-inositol

Fig. 1

This type of compound was demonstrated by Bouveault (3) to be capable of existing in seven different optically inactive forms and in one optically active pair of isomers. The biologically active form of inositol is one of the optically inactive forms known as i-inositol or meso-inositol. The actual structural configuration of meso-inositol was not determined until 1942 when the work of Dangschat and Fischer (4) and of Posternak (5) demonstrated its stereochemical structure as shown in Figure I.

Nutritional Significance: Nearly eighty years elapsed between Scherer's discovery of inositol and the first intimation that the material possessed nutritional significance. Like many other discoveries in nutrition, the recognition of the action of inositol came about through investigations in a totally different field. In this case it originated in the studies on the fabulous "bios," a hypothetical growth factor for yeast. During the course of studies on the actual existence and nature of this factor, an active concentrate was obtained and fractionated into several components possessing varying chemical and biological characteristics. One of these fractions, separated from a bios concentrate extracted from tea leaves, was reported to be a growth stimulant for yeast and was identified in 1928 by Eastcott (6) as inositol. Her work was not readily accepted at first largely because the basal media used by other workers were, at that time, inadequate in other respects and resulted in widely different findings. As the nature of bios constituents became known, making possible the preparation of adequate, synthetic growth media for yeast and other microorganisms, Eastcott's work was confirmed and the indispensability of inositol as a growth stimulant not only for yeast, but for other fungi as well (7, 8, 9) was soon established. Thus far, however, there has been no evidence indicating that any of the bacterial species require inositol. In fact, Woolley (10, 11) has pointed out that, with few exceptions, many bacteria do not even contain inositol in their cells—at least in detectable amounts. As Woolley (12) further points out, if this failure to detect inositol in several bacteria really is due to its absence from these species and does not merely represent lack of sufficient sensitivity of the assay procedure, it constitutes an exception to the current theory that all those water-soluble vitamins which are not required in the medium are synthesized by the cell.

Inositol in Animal Nutrition:

The first indication that inositol plays a significant part in the nutrition of higher animals came in 1940 when Woolley (13) reported that the mouse required a new vitamin for normal growth and for the maintenance of hair and of normal skin condition. A short time later, during the same year, Woolley (14) identified the new, so-called "mouse anti-alopecia factor" as inositol or as the calcium and magnesium salt of inositol hexaphosphate, *phytin,* a well-known constituent of cereal grains. Both phytin and inositol were found not only to prevent the deficiency condition in mice, but to cure the condition by actual restoration of hair and by stimulation of appreciable gains in weight (15).

Mouse Alopecia: The occurrence of alopecia or baldness in mice on a diet deficient in inositol was characterized by the unusual pattern of the disease. Woolley (13) found that hair was never lost from the head or tail or from the legs below the knees. Hair was lost on most other parts of the body, invariably in bilaterally symmetrical areas, and the loss in these areas was nearly complete. It is of interest to note that Martin (16) in similar studies on inositol deficiency found only slight loss of hair in the affected animals. Martin's findings may be based on differences in the basal diet used. For example, Woolley (11, 17) observed that the amount of pantothenic acid in the diet had a marked influence on the appearance of the symptoms of inositol deficiency. Thus, on a pantothenic acid free diet, alopecia developed even though the ration contained large amounts of inositol. However, in the presence of large amounts of pantothenic acid and in the absence of inositol, a significant percentage of the animals still developed signs of inositol deficiency and died unless supplements of inositol were administered.

Other Animal Species: Inositol deficiency, manifested in different forms, has been demonstrated in the rat, cotton rat, guinea pig, hamster, pig, dog and chicken. In the rat, inositol has been found to possess lipotropic activities under various conditions* (18, 19, 19a, 20, 21, 22). The so-called "spectacle-eye" condition in rats, characterized by loss of hair around the eyes, was attributed by Pavcek and Baum (22) to a deficiency of inositol, although later studies by other investigators (23) seemed to point to biotin deficiency as the cause of this symptom. Experiments by Cunha *et al* (24) on rats fed a non-purified diet (i.e., made up largely of natural foods—corn, soybean meal, alfalfa and mineral salts) resulted in poor growth of the animals and the development of an alopecia similar to that in mice described by Woolley. The symptoms were cleared up by feeding pure inositol. The natural diet provided by these workers probably supplied considerable amounts of phytin which apparently was nutritionally unavailable to the rat. This is an interesting point in view of Woolley's (14, 15) demonstration that phytin, as well as inositol, was effective in curing similar symptoms in mice. Some workers have reported that rats can be raised successfully to maturity without inositol (25, 26), while others have reported a definite increase in rate of growth of rats on purified diets supplemented with inositol (19).

One of the most significant demonstrations of the biological activity of inositol is that of McIntire, Schweigert and Elvehjem (27) who reported that the addition of this vitamin to a highly purified diet nearly doubled

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*cf. *Borden's Review of Nutrition Research,* November, 1947 "The Nutritional Role of Lipotropic Factors."

the growth rate of cotton rats. Improved growth rates, of a lesser order, were also reported by Hogan and Hamilton (28) for guinea pigs which received supplements of inositol on a partly purified diet. Cooperman *et al* (29) reported growth stimulation in hamsters following addition of inositol to a purified diet.

Hogan and Hamilton (30) in a later study did not observe improved growth following inositol supplementation in hamsters, but did find evidence indicating its necessity in the diet of this species. They found that hamsters raised on the inositol deficient diet had difficulty in reproduction. Many of the young were born dead or as bloody, shapeless masses and some of the mothers died during parturition. These disturbances did not occur in animals fed inositol.

Several reports have appeared indicating varied needs for inositol in poultry. Hegsted and coworkers (31) noted a slight improvement in the growth of chicks receiving inositol, while Jukes *et al* (32) observed similar effects in turkey poults. Lack of inositol in turkey poults was manifested, in addition to poor growth, by a special type of anemia. Dam (33) found that the brain degeneration and exudative diathesis (an accumulation of serous fluid under the skin) characteristically exhibited by vitamin E-deficient chicks could be prevented by feeding inositol. More recently, a report by Herrmann (34) indicated that accumulations of cholesterol in the tissues of old hens are demobilized by feeding inositol.

In pigs, inositol has been reported to relieve symptoms of biotin deficiency (35) apparently by stimulating intestinal synthesis of biotin.

Inositol and Other Vitamin Interrelationships:

Although an appreciable amount of evidence exists pointing to the importance of inositol in the diet of experimental animals, there is still considerable difference of opinion as to whether inositol should be regarded as a dietary essential. A large part of the discrepancy in findings among various groups and a good deal of the difficulty in evaluating results can be attributed to the profound influence which other dietary constituents have on the biological action of inositol and vice versa. Some of the observed interactions between inositol and the various vitamins are summarized below:

Inositol and Biotin: Recent experiments by Lindley and Cunha (35) with young swine indicate a possible interrelationship between inositol and biotin which may serve to reconcile the apparently contradictory findings on spectacle-eye condition in rats reported by Pavcek and Brown (22) and by Nielsen and Elvehjem (23). This relationship became apparent when various sulfonamides were incorporated into purified diets as a means of

producing experimental vitamin deficiencies.* Lindley and Cunha found no demonstrable effect on either growth or efficiency of feed utilization as a result of adding either inositol or biotin to a sulfaguanidine-containing basal ration fortified with thiamine, riboflavin, niacin, pyridoxine, pantothenic acid and choline. When, however, the sulfaguanidine was replaced by sulfathalidine, a marked biotin deficiency developed which was found to respond well to supplementation with inositol. The possibility was suggested that in the pig inositol functioned indirectly by stimulating the intestinal synthesis of biotin.

Inositol and Pantothenic Acid: Woolley's findings, previously discussed, demonstrated that the incidence of alopecia in mice was in some measure dependent upon the pantothenic acid content of the diet. The absence of pantothenic acid precipitated symptoms of alopecia even in the presence of adequate dietary inositol. That the alopecia was due primarily to inositol deficiency, however, seems to be indicated by the fact that the deficiency developed in the absence of inositol despite the inclusion of large amounts of pantothenic acid in the ration.

Inositol and Para-aminobenzoic Acid: There is considerable evidence concerning the mutual influences exerted upon each other by inositol and *p*-aminobenzoic acid, but unfortunately interpretation of the phenomena involved is still largely in a state of disagreement. Thus, Martin (36) found that the addition of *p*-aminobenzoic acid to a highly purified ration produced poor growth and changes in fur which were prevented by the addition of inositol. Similar observations were reported by Ershoff and McWilliams (37) and by Sure (38). However, when the diet was supplemented by inositol alone—and no *p*-aminobenzoic acid—a definitely harmful effect was observed which could be prevented by adding *p*-aminobenzoic acid. A final odd fact was that the diet appeared to be quite adequate when both *p*-aminobenzoic acid and inositol were absent.

Additional studies on inositol-*p*-aminobenzoic acid interrelationships by Sure (39) indicated that both of these compounds, particularly inositol, considerably improved the percentage survival of newborn rats when fed to mothers receiving a highly purified diet. In later studies Sure (38) attributed this effect to *p*-aminobenzoic acid, while Climenko and McChesney (40) supported his earlier view that inositol was responsible for this effect.

Inositol-Vitamin E-Unsaturated Fatty Acids: Several studies point to a possible interrelation among inositol, vitamin E and certain unsaturated

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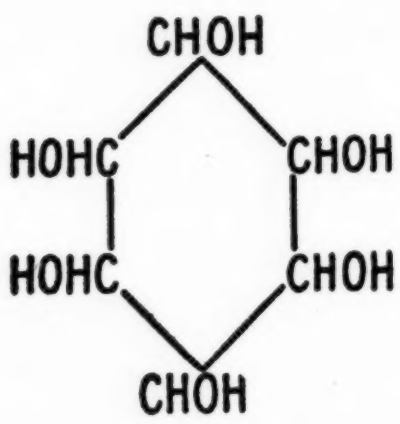
*cf. *Borden's Review of Nutrition Research,* June, 1946 "Nutrition Studies with the Sulfonamides."

fatty acids. As has been pointed out, inositol has been reported to prevent certain symptoms of vitamin E deficiency in the chick (33). It has also been shown to be effective in removing cholesterol from hen's tissues and from the aorta (34). Vitamin E has been found by Dam (41) to be effective in reducing the normal cholesterol content of chick muscles, as well as the abnormally increased muscle cholesterol of chicks fed a high cholesterol diet. Unlike inositol, however, vitamin E has no effect on the cholesterol content of the aorta, a factor of considerable significance in the phenomenon of arteriosclerosis. Furthermore, Dam (42) has shown that the nature and amount of the fatty acids in the diet markedly influence the sequence and severity of symptoms of vitamin E deficiency. The greater the percentage of unsaturated fatty acids, the more severe the manifestations of vitamin E deficiency. Similarly, Handler (43) has recently shown that unsaturated fatty acids inhibit the lipotropic activity of inositol and suggested a possible synergistic activity of inositol and vitamin E in this system, although vitamin E alone exhibits no lipotropic activity.

Inositol Antimetabolites:

At the present time only one inositol antagonist of the structurally analogous, competitive inhibitory type* is known. This is hexachlorocyclohexane, an analog of inositol in which all of the hydroxyl groups are replaced with chlorine atoms (Fig. 2). Hexachlorocylcohexane inhibits the growth of yeast (44) and fungi (45) and can be counteracted by the provision of additional inositol. Hexachlorocyclohexane is known commercially as "gammexane," a powerful fungicide developed in Britain during the war.



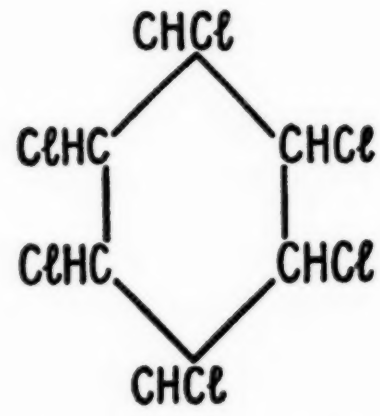


Fig. 2 ***hexahydroxycyclohexane*** ***hexachlorocyclohexane***

The activity of inositol may be affected or inhibited in ways other than competitive inhibition by the various vitamins. In addition to those already discussed, is nicotinic acid. Martin *et al* (46) observed that inositol markedly increased the peristalsis of the stomach and small intestine of the dog, while nicotinic acid caused a decrease. They suggested that the ratio of nicotinic

*cf. *Borden's Review of Nutrition Research*, October, 1946 "The Anti-Vitamins."

acid or similar compounds with respect to inositol may be the nutritional factor which determines the degree of motility of the gastrointestinal tract in the dog.

Inositol Biosynthesis:

Intestinal Biosynthesis: Presumptive evidence for the synthesis of inositol within the animal body has existed for some time. As early as 1858, for example, a medical paper appeared in which it was reported that inositol had been isolated from the urine of a patient with diabetes insipidus in quantities far in excess of the amount which, according to present knowledge, could have been obtained from food (47). The extra inositol might have arisen either as a result of synthesis or from tissue breakdown. A more positive indication of the likelihood of synthesis was reported in 1924 by Needham (48). He found that rats made to excrete abnormally large amounts of urine by excessive salt feeding, also excreted more inositol than had been ingested. Since the excess excretion of inositol continued for long periods of time, is was concluded that inositol was being synthesized by the animals.

Conclusive evidence for the intestinal biosynthesis of inositol by mice was obtained in 1942 by Woolley (11). He maintained groups of mice on a highly purified ration free of inositol. The animals were sacrificed at regular periodic intervals and their tissues analyzed for inositol content. The values found were compared with those obtained from animals on a normal adequate stock diet and from animals receiving a supplement of inositol to the purified diet. It was found that the tissues of the animals in the experimental group gradually increased in total inositol content even though none of this substance was ingested. The values were comparable to those found in control animals on the stock diet and, as may be expected, were somewhat lower than those found in animals receiving dietary supplements of inositol. Hitherto unexplained instances of spontaneous recovery from inositol deficiency alopecia were interpreted as evidence of sufficient biosynthesis of inositol in the deficient animal. This was confirmed by the observation that cultures from the intestinal tract of animals which exhibited spontaneous cure of alopecia yielded microorganisms which synthesized much more inositol than did organisms isolated in the same fashion from the intestinal tracts of mice that had become hairless. As has already been pointed out, the presence of pantothenic acid in the diet was an important factor in stimulating the biosynthesis of inositol.

Influence of Sulfonamides: A further, indirect indication of the intestinal biosynthesis of inositol in rats may be found in the studies of Nielsen

and Black (49). They found that animals on a highly purified diet containing all the known vitamins failed to grow well and developed alopecia when fed sulfasuxidine. The condition was restored to normal by the administration of inositol. This indicated either that the sulfa drug somehow increased the demands of the organism beyond its synthesizing capacities, or more likely, that the intestinal microorganisms which were checked by the bacteriostatic action of the drugs had been acting as a source of inositol.

Relation to Streptomycin: An interesting relationship has been pointed out (50) between inositol and streptomycin, one of the newer antibiotics. Streptomycin contains as part of its structure tetrahydroxymeta-diguanidino-cyclohexane, a compound which may be chemically degraded to yield an optically inactive metadiamino-inositol. It has not yet been determined whether this molecule possesses the same configuration as i-inositol. It is interesting to speculate on the possible inositol or anti-inositol activity of a compound which is not only antibiotic, but which is a closely related structural analog of inositol.

The metabolism of inositol, its biochemical role in the living organism and its potential significance in human nutrition will be described in the following issue of *Borden's Review of Nutrition Research.*

REFERENCES CITED

1. SCHERER, J. VON. Über eine neue aus dem Muskelfleischegewonnene Zuckerart. *Ann. der Chem. 73,* 322 (1850).

2. MAQUENNE, L. *Compt. rend. 104,* 207 (1887).

3. BOUVEAULT, L. De l'isomerie optique dans les corps a chaines fermées. *Bull. Soc. Chim.* (3) *11,* 144 (1894).

4. DANGSCHAT, G. and H. O. L. Fischer. Acetonierung und Konfiguration des Mesoinosits. *Naturwiss 30,* 146 (1942).

5. POSTERNAK, T. Sur la configuration de la meso-inosite, de la scyllite et d'un inosose obtenu par voie biochemique (scyllo-ms-inosose). *Helv. Chim. Acta 25,* 746 (1942).

6. EASTCOTT, E. V. Wildier's Bios. The isolation and identification of Bios I. *J. Phys. Chem. 32,* 1094 (1928).

7. KÖGL, F. and N. Fries. Über den Einfluss von Biotin, Aneurin und Meso-Inosit auf das Wachstum verschiedener Pilsarten. *Z. Physiol. Chem. 249,* 93 (1937).

8. ROBINS, W. J., J. E. Mackinnon and R. Ma. Vitamin deficiencies of trichophyton discoides. *Bull. Torrey Bot. Club 69,* 509 (1942).

9. LOCHHEAD, A. G. and G. B. Landerkin. Nutrilite requirements of osmophilic yeast. *J. Bact. 44,* 343 (1942).

10. WOOLLEY, D. W. Bacterial synthesis of inositol and its importance in the nutritional economy of mice. *J. Bact. 43,* 5 (1942).

11. WOOLLEY, D. W. Synthesis of inositol in mice. *J. Exp. Med. 75,* 277 (1942).

12. WOOLLEY, D. W. The nutritional significance of inositol. *J. Nutr. 28,* 305 (1944).

13. WOOLLEY, D. W. A new dietary essential for the mouse. *J. Biol. Chem. 136,* 113 (1940).

14. WOOLLEY, D. W. The nature of the anti-alopecia factor. *Science 92,* 384 (1940).

15. WOOLLEY, D. W. Identification of the mouse antialopecia factor. *J. Biol. Chem. 139,* 29 (1941).

16. MARTIN, G. J. The mouse antialopecia factor. *Science 93,* 422 (1941).

17. WOOLLEY, D. W. Relationship of pantothenic acid and inositol to alopecia in mice. *Proc. Soc. Exp. Biol. Med. 46,* 565 (1941).

18. GAVIN, G. and E. W. McHenry. Inositol: a lipotropic factor. *J. Biol. Chem. 139,* 485 (1941).

19. GAVIN, G., J. M. Patterson and E. W. McHenry. Comparison of the lipotropic effects of choline, inositol and lipocaic in rats. *J. Biol. Chem. 148,* 275 (1943).

19a. FORBES, J. C. Lipotropic action of inositol. *Proc. Soc. Exp. Biol. Med. 54,* 89 (1943).

20. ENGEL, R. W. Relation of B-vitamins and dietary fat to the lipotropic action of choline. *J. Nutr. 24,* 175 (1942).

21. BEST, C. H., C. C. Lucas, J. M. Patterson and J. H. Ridout. The lipotropic properties of inositol. *Science 103,* 12 (1946).

22. PAVCEK, P. L. and H. M. Baum. Inositol and spectacled eye in rats. *Science 93,* 502 (1941).

23. NIELSEN, E. and C. A. Elvehjem. Cure of spectacle eye condition in rats with biotin concontrates. *Proc. Soc. Exp. Biol. Med. 48,* 349 (1941).

24. CUNHA, T. J., S. Kirkwood, P. H. Phillips and G. Bohstedt. Effect of inositol upon rat alopecia. *Proc. Soc. Exp. Biol. Med. 54,* 236 (1943).

25. JUKES, T. H. Reproduction in rats on synthetic B complex supplement. *Proc. Soc. Exp. Biol. Med. 45,* 625 (1940).

26. RICHARDSON, L. R., A. G. Hogan, B. Long and K. I. Itschner. The number of vitamins required by the rat. *Proc. Soc. Exp. Biol. Med. 46,* 530 (1941).

27. MCINTIRE, J. M., B. S. Schweigert and C. A. Elvehjem. The nutrition of the cotton rat. *J. Nutr. 27,* 1 (1944).

28. HOGAN, A. G. and J. W. Hamilton. Adequacy of simplified diets for guinea pigs and rabbits. *J. Nutr. 23,* 533 (1942).

29. COOPERMAN, J. M., H. A. Waisman and C. A. Elvehjem. Nutrition of the golden hamster. *Proc. Soc. Exp. Biol. Med. 52,* 250 (1943).

30. HAMILTON, J. W. and A. G. Hogan. Nutritional requirements of the Syrian hamster. *J. Nutr. 27,* 213 (1944).

31. HEGSTED, D. M., G. M. Briggs, R. C. Mills, C. A. Elvehjem and E. B. Hart. Inositol in chick nutrition. *Proc. Soc. Exp. Biol. Med. 47,* 376 (1941).

32. JUKES, T. H., E. L. R. Stokstad and M. Belt. Deficiencies of certain vitamins in studies of turkey poults on a purified diet. I. Pteroylglutamic acid, riboflavin, niacin and inositol. *J. Nutr. 33,* 1 (1947).

33. DAM, H. Studies on vitamin E deficiency in chicks. *J. Nutr. 27,* 193 (1944).

34. HERRMANN, G. R. Inositol decholerization of old hens. *Proc. Soc. Exp. Biol. Med. 63,* 436 (1946).

35. LINDLEY, D. C. and T. J. Cunha. Nutritional significance of inositol and biotin for the pig. *J. Nutr. 32,* 47 (1946).

36. MARTIN, G. J. The interrelationship of *p*-aminobenzoic acid and inositol. *Am. J. Physiol. 136,* 124 (1942).

37. ERSHOFF, B. H. and H. B. MCWILLIAMS. Reproduction on purified rations containing sulfaguanidine. *Proc. Soc. Exp. Biol. Med. 54,* 227 (1943).

38. SURE, B. Dietary requirements for fertility and lactation. XXXI. Further studies on the role of *p*-aminobenzoic acid and inositol in lactation and growth of the albino rat. *J. Nutr. 26,* 275 (1943).

39. SURE, B. Role of *p*-aminobenzoic acid and inositol in lactation. *Science 94,* 167 (1941).

40. CLIMENKO, D. R. and E. W. MCCHESNEY. Role of inositol and *p*-aminobenzoic acid in normal lactation. *Proc. Soc. Exp. Biol. Med. 51,* 157 (1942).

41. DAM, H. Ineffectiveness of vitamin E in preventing cholesterol deposition in the aorta. *J. Nutr. 28,* 289 (1944).

42. DAM, H. Toxicity of fractions of hog liver fatty acids to chicks fed a vitamin E deficient diet. *J. Nutr. 28,* 297 (1944).

43. HANDLER, P. Dietary factors in the regulation of liver lipid concentration. *J. Biol. Chem. 162,* 77 (1946).

44. KIRKWOOD, S. and P. H. Phillips. The anti-inositol effect of gammahexachlorocyclohexane. *J. Biol. Chem. 163,* 251 (1946).

45. BUSTON, H. W., S. E. Jacobs and A. Goldstein. Cause of physiological activity of "gammexane." *Nature 158,* 22 (1946).

46. MARTIN, G. J., M. R. Thompson and J. Carvajal-Forero. Influence of inositol and other B-complex factors on the motility of the gastro-intestinal tract. *Am. J. Digest. Diseases 8,* 290 (1941).

47. VOHL, H. *Arch. Physiol. Heilk. 17,* 410 (1858).

48. NEEDHAM, J. The synthesis of inositol in the animal body. *Biochem. J. 18,* 891 (1924).

49. NIELSEN, E. and A. Black. Role of inositol in alopecia of rats fed sulfasuxidine. *Proc. Soc. Exp. Biol. Med. 55,* 14 (1944).

50. ANON. *i-Inositol. Chem. Div., Corn Products Sales Co., N. Y.* (1947).

NEWS DIGEST

FOLIC ACID IN RADIATION THERAPY—The use of folic acid in conjunction with routine radiation therapy in certain malignant disorders of the blood has been found to be an effective means for overcoming many of the harmful reactions to radiation therapy as well as for improving the blood condition. Results of studies on over 200 patients have recently been reported. Of this group, 122 received routine radiation therapy plus periodic blood transfusions. Although some improvement in the course of the disease was noted, the radiation reactions and depressing effects on bone marrow activity were very severe. A smaller group of 17 patients was treated with folic acid alone without any demonstrable effect on the blood disease. A combination of folic acid with the radiation and transfusion therapy was used in a group of 69 patients. In this group, the addition of folic acid apparently decreased the harmful and depressant effects of radiation therapy on the bone marrow. In addition, less frequent transfusions were needed and a more beneficial influence as the course of the disease during radiation therapy was noted. *Am. J. Med. 1,* 634 (1946).

TRYPTOPHANE REQUIREMENT — A tentative figure for the requirement of the amino acid, tryptophane, was recently established on the basis of careful tests yielding identical results in two human subjects. In each, the minimum level compatible with consistent nitrogen equilibrium proved to be 0.15 gm. per day. Dr. Rose cautioned that it would not be a safe procedure to recommend the minimum intake of any dietary component, since some variation in the requirement may occur in different individuals. In all probability the daily intakes which will be recommended will exceed the minimum by 100 per cent, to provide a sufficient "factor of safety," at least in normal individuals. That this is true of tryptophane is shown by the fact that 18 persons have been kept in nitrogen balance with daily intakes of 0.3 gm or less.

The following table has been prepared to show the approximate quantities of generally used foods needed to furnish 0.3 gm. of tryptophane.

FOOD	QUANTITY
Whole milk	650 cc.
Whole eggs	150 gm.
Calf liver	100 gm.
Lean beef	145 gm.
White bread	275 gm.
Cooked rolled oats	850 gm.

—*J. Am. Diet. Assoc. 23,* 107 (1947)

VITAMIN RETENTION IN DRIED MEATS — Commercial samples of dehydrated pork and corned beef hash were analyzed to determine the extent of vitamin retention following processing and storage. No significant loss of riboflavin or of niacin was found in either product at temperatures between 0° and 120°F. after storage periods up to 42 weeks Thiamine was stable at 40°F., but with an increase in temperature to 70°F. there was a noticeable loss after 30 days and a large loss after 42 weeks. At 100° and 120°F. the loss was apparent after one week and almost complete after 10 weeks' storage. The stability of biotin was similar to that of riboflavin and niacin, whereas folic acid resembled the pattern of thiamine.—*Food Research 11,* 419 (1946).

EFFECT OF SALAD DRESSINGS ON VITAMIN C — Salads made with French dressing were found to retain more

of the vitamin C of the greens than similar salads made with the same amount of plain vinegar (acetic acid). The explanation for this observation may lie in the fact that vinegar apparently contains traces of metals which hasten the oxidative destruction of vitamin C. Seasonings in the French dressing, however, were thought to exert a protective action on the vitamin. The losses in vitamin C became apparent after a period of two hours during which the salads, mixed with dressing, were kept standing in enameled bowls at room temperature. Following good culinary practice which dictates that greens be served well chilled and mixed with the dressing just before eating, therefore, insures not only palatable salads, but maximum retention of their vitamin content.—*Food Research 12*, 27 (1947).

B-VITAMINS AND FOOD UTILIZATION—Animal experiments have indicated that vitamin B complex deficiency interferes seriously with the intestinal absorption of glucose. Such deficiency also causes marked loss of appetite and, consequently, of weight. A striking increase above normal was observed with respect to intestinal absorption of glucose, food consumption, food utilization, and weight gain in animals during recovery from such a deficiency with a vitamin B complex supplement. No one individual component of the B complex was found to be alone responsible for these effects. Thiamine was found to have the greatest influence on the digestive functions of the body during recovery. Pantothenic acid and riboflavin were less effective. Pyridoxine seemed to be least effective. The investigators stress the importance of the vitamin B complex in the nutritional rehabilitation of war-stricken populations. They point out that since the B vitamins increase the efficiency of food utilization, the effect is virtually that of augmenting available food sources.–*Gastroenterology* 7, 469 (1946).